CHAPTER 5

PIPELINE DEVELOPMENT PLAN
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Please note this long-term framework planning is not a business or operational plan, and is unconstrained to capital planning and independent to other more detailed Transnet business and operating division (OD) plans. The LTPF is only a planning tool, to guide Transnet and all external and public stakeholders. The LTPF is published annually at [www.transnet.net](http://www.transnet.net).
### ACRONYMS AND ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACSA</td>
<td>Airports Company South Africa</td>
</tr>
<tr>
<td>bpd</td>
<td>Barrels Per Day</td>
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<tr>
<td>CEF</td>
<td>Central Energy Fund</td>
</tr>
<tr>
<td>CF2</td>
<td>Clean Fuels 2</td>
</tr>
<tr>
<td>CNG</td>
<td>Compressed Natural Gas</td>
</tr>
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<td>COP</td>
<td>Crude Oil Pipeline</td>
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<tr>
<td>CTIA</td>
<td>Cape Town International Airport</td>
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<td>CTL</td>
<td>Coal to Liquids</td>
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<tr>
<td>DDOP</td>
<td>Durban Dig-out Port</td>
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<tr>
<td>DFI T</td>
<td>Durban Fuel Import Terminal</td>
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<td>DJP</td>
<td>Durban to Johannesburg Pipeline</td>
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<td>DOE</td>
<td>Department of Energy</td>
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<td>DRC</td>
<td>Democratic Republic of the Congo</td>
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<td>FAME</td>
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<td>Giga Joule</td>
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<td>NMPP</td>
<td>New Multi-Product Pipeline</td>
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<td>ORTIA</td>
<td>O.R. Tambo International Airport</td>
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<td>Oiltanking Grindrod Calulo</td>
</tr>
<tr>
<td>PDM</td>
<td>Positive Displacement Meter</td>
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<tr>
<td>PHEV</td>
<td>Plug-in Hybrid Electric Vehicles</td>
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<tr>
<td>ppm</td>
<td>Parts per Million</td>
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<tr>
<td>ROMCO</td>
<td>Republic of Mozambique Pipeline Investments Company</td>
</tr>
<tr>
<td>SFF</td>
<td>Strategic Fuel Fund</td>
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<tr>
<td>TNPA</td>
<td>Transnet National Ports Authority</td>
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<td>TPL</td>
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PIPELINE DEVELOPMENT PLAN

1. INTRODUCTION

This chapter of the Long-Term Planning Framework (LTPF) summarises the national pipeline development plans for South Africa, comprising the pipelines owned and operated by Transnet and pipelines owned and operated by other entities (private terminal operators, oil companies and freight logistics operators).

The LTPF provides a national overview of the liquid petroleum and gas requirements of South Africa. The overview is aligned to the National Energy Security Master Plan, other related master plans and falls within the prescribed Regulatory Framework. Liquid petroleum includes crude oil and refined fuels. Refined fuels transported in pipelines in South Africa include petrol, diesel and jet fuel. Natural gas and methane rich gas are also transported in pipelines.

Included in this section are key pipeline planning goals used to generate the long-term pipeline plans, an analysis of the current pipeline trends and related issues, and an overview of the national pipeline network. The summarised liquid petroleum and gas demand forecast for the next 30 years is shown. Following the demand forecast, the pipeline and terminal storage development plans to meet the demand for South Africa are described.

The pipeline development plan concludes with an assessment of new emerging technologies that may impact on the proposed development plan, followed by an overview of the planned pipeline and terminal investments over both a seven and 30-year period in South Africa.

Transnet’s current New Multi-Product Pipeline (NMPP) project consists of a collection of sub-projects, of which the major investments include a 24-inch Multi-Product Pipeline (MPP24) and accumulator terminals at the coast in Durban and inland at Jameson Park in Gauteng. In addition, the NMPP project includes two 16-inch pipelines (from Kendal to Waltloo and Jameson Park to Alrode) to enhance the capability of the existing northern pipeline distribution network. The new MPP24 pipeline and two other line sections are now complete, but the two accumulator terminals (TM1 and TM2) are still to be completed and commissioned.

1.1 KEY ASSUMPTIONS

The following assumption was made for this LTPF:

• A new 300 000bpd refinery, Mthombo, is commissioned in 2025.

The LTPF also considers two scenarios for pipeline development in South Africa over the next 30 years, to support the proposed Mthombo oil refinery at the Port of Ngqura. Two pipeline scenarios considered for transporting project Mthombo’s refined fuel to the hinterland are as follows:

• Scenario 1: Transport refined fuel via proposed Ngqura to Gauteng pipeline (NGP); and
• Scenario 2: Ship refined fuel from Ngqura to Durban and then transport via the MPP24 to Gauteng.

1.2 PLANNING GOALS

The following general planning goals were used to inform the development of South Africa’s long-term pipeline and terminal plans:

• Follow a common user principle in developing an integrated liquid fuels supply system;
• Meet the market demand and provide equitable access and capacity for all parties that want to participate in the oil and gas business sector;
• Provide a logical range of facilities to meet local as well as hinterland demand and avoid duplication of investment;
• Review capital investment, minimising regret investments across the oil and gas sector to meet the long-term national demand for liquid fuels;
• Facilitate security of supply objectives of the Department of Energy, comply with the Petroleum Pipeline Act and the Gas Act;
• Align with the planning initiatives of local, provincial, national Government and other key stakeholders;
• Improve infrastructural and operational efficiencies and reduce transport and logistics costs;
• Review existing storage and back-of-port logistics areas to increase capacity;
PIPEDLINE DEVELOPMENT PLAN

- Integrate and align pipeline with port and oil terminal capacity planning;
- Align pipeline and terminal development planning with trends in oil and gas logistics;
- Maintain the flexibility to respond to changing technological and economic conditions; and
- Respond to environmental opportunities and constraints in a sustainable manner.

1.3 KEY ISSUES

The key issues that influence long-term pipeline and terminal planning are identified as:

- The need for sustainability in developing infrastructure solutions, as well as increased stakeholder engagement on key issues;
- Government’s Clean Fuels 2 Programme and the impact on security of supply;
- National product specifications vs. pipeline product injection and delivery specifications;
- Slow-down in local economy and lower fuel demand;
- Worldwide trend towards greater specialisation, centralisation and economies of scale;
- Implementation of new refining capacity and strategic reserves (stocks);
- Developments of alternative routes by landlocked countries;
- Restructuring of logistics networks, and improvement in dealing with capacity constraints at terminals and intermodal transport links;
- Transport and handling of alternative forms of energy, such as liquid natural gas (LNG), natural gas (NG) and compressed natural gas (CNG);
- The award of leases by Transnet National Ports Authority (TNPA) in the existing Durban port and impact on the rationalisation of oil industry infrastructure in Island View and the proposed new Durban Dig-out Port (DDOP);
- The modal shift from road to pipeline to reduce the cost of logistics and enhance safety; and
- The timing and location of a new crude oil refinery.

1.4 REGULATORY FRAMEWORK

The regulatory framework within which pipelines for liquid fuels and gas operate in South Africa is depicted below.
The National Energy Regulator of South Africa (NERSA) regulates pipelines within the ambit of the Petroleum Pipeline Act and the Gas Act as well as all the associated regulations, thus NERSA functions as:

- The Gas Regulator in terms of the Gas Act;
- The Petroleum Pipeline Regulator under the Petroleum Pipelines Act;
- The Regulator and overseer of all of Transnet Pipelines activities; and
- An Authority on Transnet Pipelines’ tariffs based on the ‘allowable revenue’ principle.

1.4.1 REGULATORY CHALLENGES

There are six different economic regulators in the petroleum value chain and these regulators have overlapping jurisdiction. These overlapping jurisdictions inhibit the investment in infrastructure. Examples of overlapping jurisdictions include:

- DOE and NERSA use different tariff/price methodologies for the same asset;
- TNPA authorises investment in ports (bidding rounds, leases etc.), while NERSA authorises licences and regulates the tariffs; and
- The term of lease in the port (TNPA) and depreciation period for the assets (NERSA) is not aligned.

The delay in the implementation of a compensation mechanism for the next phase of the clean fuels programme has led to investment uncertainty in the upgrade of existing refineries. This delay has created an opportunity for the import of cleaner fuels, which puts local refineries under pressure to compete with a product which they cannot produce and could ultimately lead to refinery closures.

Infrastructure investment requires regulatory certainty. It is therefore important to address these regulatory challenges in order to ensure timely investment in the liquid fuels industry supply chain.

1.4.2 NATIONAL DEVELOPMENT PLAN (NDP)

The NDP (National Development Plan) defines specific actions for economic infrastructure, as summarised in the figure below.

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**Figure 2: National Development Plan Actions for Oil and Gas Industry**

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*Transnet SOC Ltd © LTPF 2016*
1.5 SUSTAINABLE PIPELINE DEVELOPMENT

One of the key issues identified in the development of pipeline infrastructure is the requirement for sustainable solutions. Sustainability of infrastructure relates to its performance lifespan and durability while also examining the social, economic and environmental impacts the development will have throughout its lifespan. Sustainable infrastructure design is not simply about new infrastructure. It also entails rehabilitation, reuse or optimisation of existing infrastructure. Nine development outcomes of sustainable infrastructure have been identified being: employment, skills development, industrial capability building, investment leverage, regional integration, transformation, health and safety, community development, and environmental stewardship.

For the existing pipelines, sustainable impacts (social, economic and environmental) will result mainly from operations and maintenance activities. As per the Transnet LTPF SEA conducted for existing Transnet pipelines, the following environmental sensitivities were identified:

- The Critically Endangered Vaal River is crossed by the Refined Products Pipeline;
- Biodiversity sensitivities along the Refined Products Pipeline include the Critically Endangered Blesbokspruit and Klipriver Highveld Grassland Habitats;
- The Critically Endangered Wilge River is crossed by the Crude Oil Pipeline; and
- Critically Endangered Wetland Habitats are concentrated as the lines approach Gauteng and the coastal cities and extend along the Natal Coastline.

To mitigate the risk of leaks, regular maintenance and monitoring must be undertaken to ensure that leaks do not occur and when they occur they are quickly addressed. The spatial assessment of proposed pipelines will have to be conducted once routing is confirmed, in order to establish the possible impact that these pipelines may have.
1.6 PIPELINE NETWORK

1.6.1 NATIONAL PIPELINE NETWORK

The following diagram illustrates the existing national pipeline network as well as potential future new pipelines within South Africa, including non-Transnet owned pipelines.

Figure 3: National Pipeline Network

1.6.2 NON-TRANSNET PIPELINE NETWORK

CHEVRON CRUDE PIPELINE

An existing 16-inch, 108km pipeline runs from the Strategic Fuel Fund (SFF) tank farm in Saldanha Bay to the Chevron refinery in Milnerton, Cape Town.

Other pipelines exist between the refinery and the Cape Town harbour. These include a 26-inch, 13km crude pipeline, a 10-inch heavy fuel oil line and a 12-inch, 13km multi-product (white oil) pipeline (bi-directional).

ROMPCO GAS PIPELINE

Rompco, a gas pipeline 50% owned by Sasol, 25% by the South African Government (CEF) and 25% by the Mozambique Government, runs a natural gas pipeline from Mozambique to South Africa. Gas has been supplied through the pipeline 865km from the Pande and Temane fields in Mozambique to Secunda since March 2004. The gas from Mozambique is marketed in Gauteng and KwaZulu-Natal, primarily for industrial use.
PIPELINE DEVELOPMENT PLAN

PETROSA OFFSHORE GAS PIPELINE
A 450mm diameter, 85km gas pipeline from the offshore FA Platform to the onshore gas-to-liquids (GTL) refinery in Mossel Bay.

PETROSA OFFSHORE CONDENSATE PIPELINE
A 200mm diameter, 85km condensate pipeline from the offshore FA Platform to the onshore gas-to-liquids refinery

1.6.3 PROPOSED PIPELINES

NGQURA TO GAUTENG PIPELINE (NGP)
A new pipeline is proposed to supply liquid fuel from the proposed Mthombo refinery in Ngqura to Gauteng. The pipeline is estimated to be 1 000km long and have a design flow rate of 1 500m³ per hour or design capacity of 13.1 billion litres per annum.

MAPUTO TO GAUTENG PIPELINE
Petroleum RSA (Pty) Ltd, together with Petroline SARL (Mozambican), are shareholders of Petroline Holdings, the company that will operate the pipeline from Maputo to Kendal. Petroleum has a 25-year licence to construct and operate a 16-inch pipeline with a capacity of 3.5 billion litres per annum.

WEST COAST GAS PIPELINE
The West Coast pipeline system is envisaged to potentially connect the Kudu and Ibhubesi gas fields off the coast of southern Namibia to a potential future national South African gas pipeline system.

This system will consist of various pipelines from the offshore gas fields, south to Cape Town and possibly to Mossel Bay, Port Elizabeth and east to Gauteng. An alternative route similar to NGP from the Eastern Cape could link into Gauteng and provide a transmission system for shale gas. A spur to East London could also be considered.

MOSSEL BAY LNG IMPORTS
The South African national oil company, PetroSA’s study to import liquefied natural gas (LNG) via an import facility at Mossel Bay in the Western Cape has indicated that it is not feasible due to port and marine conditions. The facility would have enabled PetroSA to import LNG to supplement gas reserves at the company’s GTL refinery.

Other options for the import of LNG and possible supplementation to GTL refinery are being considered. The supply of LNG to other potential off-takers, such as electricity producers, is considered crucial to the success of the project.

PetroSA’s project Ikhwezi was designed to extend the life of the GTL refinery for six years up to 2020. Further development of other gas prospects near to the F-O field could potentially sustain the life of the refinery until 2025. The gas developments have various challenges and PetroSA is considering alternative options for the extension of the life of the manufacturing facility.

BOTSWANA REFINED FUELS PIPELINE
Botswana’s liquid fuel demand is increasing. A pipeline option for the supply of fuel to Gaborone is being investigated. Different options are considered for this new pipeline. A new line can be constructed from Tarlton to Tshele Hills (40km from Gaborone) or the existing pipeline from Tarlton to Rustenburg can be upgraded and a new pipeline constructed from Rustenburg to Tshele Hills.

SALDANHA BAY – ATLANTIS LNG IMPORTS
A potential LNG import terminal is considered in Saldanha Bay, with a new natural gas pipeline from Saldanha Bay to Atlantis to supply the Ankerlig power station.
1.6.4 TRANSNET PIPELINE NETWORK

The following diagram depicts Transnet’s existing pipeline network within South Africa.

During the 1960s the existing railway lines from Durban and Mozambique did not have sufficient capacity to meet the demand of the Gauteng hinterland for refined petroleum products. By 1965 a multi-product 12-inch pipeline, generally known as the Durban Johannesburg pipeline (DJP), was constructed. The pipeline has reached the end of its technical and economic life and is currently being replaced by the new 24-inch Multi-Product Pipeline (MPP24).

The DJP is currently utilised for transporting petrol from Durban to the inland network, and both petrol and diesel to Ladysmith, Bethlehem and Kroonstad. This will continue until the MPP24 is ready to transport multi- upon completion of the accumulator terminals. The DJP can transport jet fuel to O.R. Tambo International Airport (ORTIA) if required, but it is not currently part of the normal operational pattern, however, the option is available for strategic security of supply purposes.

The current operating capacity of the DJP is 3,72 billion litres per annum. Decommissioning of the pipeline is planned when the MPP24 becomes fully operational.
PIPELINE DEVELOPMENT PLAN

METHANE-RICH GAS PIPELINE

A second 16-inch refined multi-product pipeline, from Durban to Witwatersrand (DWP) followed in 1973, but the subsequent construction of the Secunda coal-to-liquids refinery rendered the pipeline underutilised. In 1995 a section of the pipeline was reconfigured to convey methane-rich gas from Secunda to Durban, via Empangeni, known as the Lilly line.

The Lilly line (600km) carries methane-rich gas from Secunda to Durban with off-take points at Newcastle, Empangeni/Richards Bay and the Durban area. The maximum capacity of this pipeline is 23 million GJ per year. It is expected that demand will exceed the line's capacity in the early 2020s.

NEW 24 INCH MULTI-PRODUCT PIPELINE (MPP24)

The new MPP24 (825km) includes the Durban to Jameson Park trunk line, from where it ties into the inland network at the Jameson Park Terminal near Heidelberg. The new pipeline and debottlenecking and upgrades to the inland network have been completed and the network is fully operational. Additional pipelines implemented as part of the overall NMPP project included a 16-inch multi-product pipeline from Kendal to Waltloo and a 16-inch multi-product pipeline from Jameson Park to Alrode.

Currently the MPP24 trunk line is used to transport 500ppm diesel from Durban to Jameson Park. Petrol will be introduced into the MPP24 trunk line when the Coastal (TM1) and Jameson Park (TM2) terminals are commissioned, enabling the pipeline to carry multiple product grades.

The MPP24 is designed to transport jet fuel from Durban to Jameson Park from where it will be transported by an existing 16-inch pipeline via Alrode and into a section of the current DJP to ORTIA. A future dedicated jet fuel line is planned from Jameson Park to ORTIA.jet fuel will be introduced into the MPP24 when a technically feasible solution is found to address Clean Fuels 2 product quality issues and when inland jet fuel demand is sufficient. Current capacity to supply jet fuel to ORTIA by rail and the dedicated jet fuel pipeline from Sasolburg to ORTIA are expected to be insufficient from 2019 onwards. The management of jet fuel in the MPP24 requires special attention due to strict quality management requirements. The proposed operating philosophy will require re-batching and quality certification at TM2 before transfer to ORTIA.

The current installed capacity of the MPP24 trunk line is 8,76 billion litres per annum.

JET FUEL PIPELINE (AVTUR)

The aviation turbine fuel is a commodity known as Avtur or jet fuel. The current dedicated pipeline (94km) transports jet fuel from the Natref refinery in Sasolburg to ORTIA east of Johannesburg.

The demand on the dedicated jet fuel pipeline is dependent on the production at Natref (supplemented by synthetic jet fuel from Secunda) rather than demand at ORTIA. The line currently operates close to its maximum capacity and will continue to run at this operating capacity into the foreseeable future.

The installed capacity of the pipeline is 1,3 billion litres per annum.

CRUDE OIL PIPELINE (COP)

The COP was commissioned in 1971 to transport crude oil from Durban to the inland crude refinery Natref in Sasolburg, as well as to the used coal mines in Ogies (Kendal node) as part of the then strategic reserves.

A reconfiguration of the 18-inch crude and 16-inch DWP systems were done with the introduction of methane rich gas. The reconfigured COP (580km) consists of a 16-inch section and an 18-inch section. Capacity was increased during 2002, triggered by the Natref refinery capacity expansion, by adding five en-route (booster) pump stations, which gave the pipeline sufficient capacity to meet current and anticipated future demand.

With the introduction of the Clean Fuels 1 programme Natref’s refining capability was effectively reduced resulting in unused capacity of approximately 100m³ per hour in the COP. With the introduction of the Clean Fuels 2 programme, currently promulgated, it is expected that Natref would increase production to nameplate capacity and the COP would again operate at design capacity.

The current installed capacity of the COP is 7,3 billion litres per annum.
2. LIQUID PETROLEUM AND GAS DEMAND

The liquid fuels demand is split between an inland demand and a coastal demand. These areas are defined as per the figure below. Botswana and Lesotho form part of the inland demand area while Namibia and Swaziland are within the coastal demand areas. Botswana, Lesotho, Swaziland and Namibia are all members of the South African Customs Union.

The supply to other Southern African countries, e.g. Zimbabwe, Zambia and DRC is defined as overland exports.

![Map of Southern Africa showing inland and coastal demand areas](image)

*Figure 5: Inland and Coastal Demand Areas*

2.1 NATIONAL DEMAND FORECAST

The table and graph below indicate the national demand forecast for petrol, diesel and jet fuel in billion litres per annum for the period 2015 to 2044. The demand includes South Africa, Botswana, Lesotho, Namibia, Swaziland and exports to markets in Southern Africa.

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<td><strong>31,59</strong></td>
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<td><strong>82,95</strong></td>
</tr>
</tbody>
</table>

*Table 1: South Africa Refined Fuel (Petrol, Diesel and Jet fuel) Demand*
PI PELINE DEVELOPMENT PLAN

Crude Oil Pipeline (COP)

The average growth in petrol consumption is expected to be approximately 1,2% per annum over the period while average diesel growth is anticipated to be 5%. Jet fuel average growth is expected to be approximately 2,3% for the period.

![Figure 6: South Africa Refined Fuel (Petrol, Diesel and Jet Fuel) Demand](image)

### 2.1.1 INLAND REFINED FUEL SUPPLY AND DEMAND FORECAST

The following table indicates the inland supply and demand for refined fuels for the 30-year period 2015 to 2044. Inland demand includes volumes to Lesotho and Botswana, but excludes over border exports. The rail from the coast includes the jet supplied from Durban to O.R. Tambo International Airport.

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</thead>
<tbody>
<tr>
<td>Total inland demand</td>
<td>19.2</td>
<td>19.8</td>
<td>20.4</td>
<td>21.0</td>
<td>21.6</td>
<td>22.2</td>
<td>22.9</td>
<td>25.0</td>
<td>35.6</td>
<td>55.9</td>
</tr>
<tr>
<td>Supply from inland refineries</td>
<td>9.2</td>
<td>9.2</td>
<td>9.3</td>
<td>9.0</td>
<td>8.8</td>
<td>9.4</td>
<td>9.4</td>
<td>9.6</td>
<td>9.5</td>
<td>9.6</td>
</tr>
<tr>
<td>Supply from coast</td>
<td>10.1</td>
<td>10.6</td>
<td>11.1</td>
<td>12.0</td>
<td>12.7</td>
<td>12.8</td>
<td>13.4</td>
<td>15.4</td>
<td>26.1</td>
<td>46.3</td>
</tr>
<tr>
<td>Supply from coast by road</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>1.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Supply from coast by rail</td>
<td>3.2</td>
<td>3.6</td>
<td>3.4</td>
<td>2.9</td>
<td>3.1</td>
<td>2.8</td>
<td>2.1</td>
<td>2.1</td>
<td>3.5</td>
<td>8.4</td>
</tr>
<tr>
<td>Supply from coast by pipeline</td>
<td>6.8</td>
<td>7.0</td>
<td>7.6</td>
<td>9.1</td>
<td>9.6</td>
<td>10.0</td>
<td>11.3</td>
<td>13.2</td>
<td>21.7</td>
<td>36.6</td>
</tr>
<tr>
<td>Total supply to inland</td>
<td>19.2</td>
<td>19.8</td>
<td>20.4</td>
<td>21.0</td>
<td>21.6</td>
<td>22.2</td>
<td>22.9</td>
<td>25.0</td>
<td>35.6</td>
<td>55.9</td>
</tr>
</tbody>
</table>

Table 2: Inland Refined Fuels Supply and Demand Forecast (2015 to 2044)
The following graph shows the supply required to satisfy the inland demand. The inland production is supplemented by product from the coast, transported by road, rail and pipelines. The pipeline supply consists of the DjP, MPP24 and or the NGP pipeline.

Figure 7: Inland Refined Fuels Supply and Demand Forecast (2015 to 2044)

2.2 Refined Fuel Pipeline Demand

The following table shows pipeline utilisation for the period 2015 to 2044 for scenario 1 based on the forecasted demand requirements.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>DJP</td>
<td>2,5</td>
<td>1,4</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
</tr>
<tr>
<td>MPP24</td>
<td>4,3</td>
<td>5,5</td>
<td>7,6</td>
<td>9,1</td>
<td>9,6</td>
<td>10,0</td>
<td>11,3</td>
<td>13,2</td>
<td>11,8</td>
<td>25,3</td>
</tr>
<tr>
<td>NGP (Start date:2025)</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>9,9</td>
<td>9,7</td>
<td></td>
</tr>
<tr>
<td>Alternative supply corridor</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>1,7</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,81</td>
<td>6,97</td>
<td>7,64</td>
<td>9,07</td>
<td>9,62</td>
<td>9,95</td>
<td>11,3</td>
<td>13,2</td>
<td>21,72</td>
<td>36,60</td>
</tr>
</tbody>
</table>

Billion litres per annum

Table 3: Refined Fuel Pipeline Demand: Scenario 1 with NGP
The following table shows the various pipeline utilisations for the period 2015 to 2044 for scenario 2 based on the forecasted demand requirements.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>DJP</td>
<td>2,5</td>
<td>1,4</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
</tr>
<tr>
<td>MPP24</td>
<td>4,3</td>
<td>5,5</td>
<td>7,6</td>
<td>9,1</td>
<td>9,6</td>
<td>10,0</td>
<td>11,3</td>
<td>13,2</td>
<td>21,4</td>
<td>25,3</td>
</tr>
<tr>
<td>NGP</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
</tr>
<tr>
<td>Alternative supply corridor</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
<td>0,0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,81</strong></td>
<td><strong>6,97</strong></td>
<td><strong>7,64</strong></td>
<td><strong>9,07</strong></td>
<td><strong>9,62</strong></td>
<td><strong>9,95</strong></td>
<td><strong>11,30</strong></td>
<td><strong>13,23</strong></td>
<td><strong>21,37</strong></td>
<td><strong>36,14</strong></td>
</tr>
</tbody>
</table>

*Billion litres per annum*

Table 4: Refined Fuel Pipeline Demand: Scenario 2 with Coastal Shipping
2.2.1 JET FUEL DEMAND

The table below indicates the inland jet fuel supply and demand for the 30-year period in billion litres per annum. The various jet fuel supply sources are shown separately and consist of supplies from Natref (Sasolburg) in the dedicated jet fuel pipeline to ORTIA, the supply from the coast by rail and road, and the demand requirement to be supplemented in the MMP24. The current demand forecast indicates that the rail and dedicated Sasolburg pipeline capacity need to be supplemented to service the inland jet demand. This additional capacity is supplied by the DJP/MPP24.

Table 5: Jet Fuel Supply and Demand for Inland Area for the Period 2015 to 2044

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</thead>
<tbody>
<tr>
<td>Avtur line</td>
<td>1,02</td>
<td>1,06</td>
<td>1,09</td>
<td>0,39</td>
<td>0,39</td>
<td>0,39</td>
<td>0,39</td>
<td>0,39</td>
<td>0,77</td>
<td>0,86</td>
</tr>
<tr>
<td>Durban - Ortia rail</td>
<td>0,73</td>
<td>0,73</td>
<td>0,73</td>
<td>0,73</td>
<td>0,73</td>
<td>0,73</td>
<td>0,73</td>
<td>0,73</td>
<td>0,73</td>
<td>0,73</td>
</tr>
<tr>
<td>DJP/MPP24</td>
<td>0,00</td>
<td>0,00</td>
<td>0,00</td>
<td>0,74</td>
<td>0,78</td>
<td>0,82</td>
<td>0,86</td>
<td>0,98</td>
<td>1,10</td>
<td>1,77</td>
</tr>
<tr>
<td>Total</td>
<td>1,75</td>
<td>1,79</td>
<td>1,82</td>
<td>1,86</td>
<td>1,90</td>
<td>1,93</td>
<td>1,97</td>
<td>2,10</td>
<td>2,60</td>
<td>3,36</td>
</tr>
</tbody>
</table>

(Billion litres per annum)

Table 6: Crude Oil Pipeline − Supply and Demand − 2015 to 2044

2.3 CRUDE OIL PIPELINE DEMAND

The table below indicates the long-term forecasted inland crude demand. The crude oil pipeline from Durban to Sasolburg (COP system) supplies Natref, the inland refinery owned by Sasol and Total. It is not expected that the shareholders will increase the refinery capacity beyond its current nameplate design of 108,7bpd as part of the Clean Fuels 2 (CF2) programme.

The current promulgated implementation date for CF2 is July 2017. The ability to achieve this date is compromised due to the funding mechanism for the CF2 programme not being finalised by Government. The oil industry requires five years from investment decision to implement the changes at their refineries. The earliest anticipated completion date of the CF2 upgrades is 2020.

Table 6: Crude Oil Pipeline − Supply and Demand − 2015 to 2044

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</tr>
</thead>
<tbody>
<tr>
<td>Durban - Sasolburg</td>
<td>6,1</td>
<td>6,5</td>
<td>6,0</td>
<td>6,2</td>
<td>6,1</td>
<td>6,3</td>
<td>5,9</td>
<td>6,1</td>
<td>6,1</td>
<td>6,1</td>
</tr>
<tr>
<td>Saldanha Bay - Cape Town</td>
<td>4,8</td>
<td>4,8</td>
<td>4,8</td>
<td>4,8</td>
<td>4,8</td>
<td>4,8</td>
<td>4,8</td>
<td>4,8</td>
<td>4,8</td>
<td>4,8</td>
</tr>
<tr>
<td>Total crude pipelines</td>
<td>11,0</td>
<td>11,3</td>
<td>10,8</td>
<td>11,0</td>
<td>10,9</td>
<td>11,1</td>
<td>10,7</td>
<td>10,9</td>
<td>10,9</td>
<td>10,9</td>
</tr>
</tbody>
</table>

(Billion litres per annum)

The fluctuation in the demand curve in the initial years is due to short term refinery shut-down and maintenance requirements.
2.4 GAS PIPELINE DEMAND

The following table indicates the gas demand in the pipelines to supply the various markets in South Africa:

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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total gas pipelines</td>
<td>4,18</td>
<td>4,20</td>
<td>4,20</td>
<td>4,21</td>
<td>4,22</td>
<td>4,23</td>
<td>4,27</td>
<td>4,27</td>
<td>4,39</td>
<td>4,54</td>
</tr>
</tbody>
</table>

Billion litres per annum

Table 7: Gas Pipeline Demand

The offshore - Mossel Bay pipeline supplies the GTL refinery in Mossel Bay, the Lilly pipeline (Secunda to Durban) supplies various industrial users and the Temane - Secunda pipeline supplies natural gas feedstock to the Sasol plants in Secunda and Sasolburg and to industrial users as an energy carrier.

Currently more than 120 million GJ of natural gas or methane-rich gas is delivered, per annum, to customers in Gauteng, Free State, KwaZulu-Natal and Mpumalanga.
The South African gas market is currently small in relation to other energy sources. It does, however, have the potential for significant growth if commercially viable gas discoveries are developed.

2.5 Refined Fuel Imports

Based on the current growing demand for liquid fuels and the lack of investment in refining or alternative liquid fuel manufacturing capacity, South Africa and the region will remain short of product in the foreseeable future. This will result in growing import volumes of final product and components. The following tables indicate forecasted imports into key regional ports for the period 2015 to 2044 for scenario 1 (with NGP) and scenario 2 (no NGP). Note that the tables are similar up to 2024, where after new manufacturing capacity is introduced in 2025.

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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Durban</td>
<td>4.5</td>
<td>5.2</td>
<td>5.8</td>
<td>6.9</td>
<td>7.6</td>
<td>7.2</td>
<td>9.5</td>
<td>11.4</td>
<td>34.5</td>
</tr>
<tr>
<td>Cape Town</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.8</td>
<td>2.0</td>
<td>4.9</td>
</tr>
<tr>
<td>Maputo</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Walvis Bay</td>
<td>1.0</td>
<td>1.0</td>
<td>1.1</td>
<td>1.1</td>
<td>1.2</td>
<td>1.1</td>
<td>1.3</td>
<td>1.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Total</td>
<td>6.5</td>
<td>7.3</td>
<td>8.1</td>
<td>9.3</td>
<td>10.2</td>
<td>9.8</td>
<td>12.4</td>
<td>14.8</td>
<td>42.5</td>
</tr>
</tbody>
</table>

Table 8: Import Forecast of Refined Fuels into Southern Africa for the Period 2015 to 2044 (Scenario 1)
The current back of port infrastructure is mainly owned by oil majors thus making it difficult for third parties to import product unless the oil majors have uncommitted capacity. Such capacity is available at market rates as approved by NERSA. Independent third-party terminal operators have entered the market in various ports to provide storage and handling services.

The key South African port for the import of product into South Africa is Durban with smaller volumes into Cape Town, Maputo and Mossel Bay. Walvis Bay is the main port of entry for Namibia. Coastal shipping arrangements deliver fuel to industry storage facilities in Port Elizabeth, East London and Walvis Bay with fuel oil being shipped to Richards Bay.
3. PIPELINE DEVELOPMENT PLAN

3.1 DEVELOPMENT SCENARIOS

The proposed Mthombo oil refinery at the Port of Ngqura is a Government initiative motivated by concerns about Security of Supply (SoS) of liquid fuels, specifically in that:

- The Government requires 30% of South Africa’s crude requirements to be sourced by non-international oil companies (IOCs);
- Concerns regarding South Africa’s reduced crude oil refining capacity; and
- The need for a more involved national oil company (NOC) as an instrument of SoS.

Two pipeline scenarios were developed for the Long-Term Planning Framework (LTPF) to support the proposed Mthombo refinery in transporting refined fuel to the hinterland:

- Scenario 1: Transport refined fuel via proposed Ngqura to Gauteng pipeline (NGP); and
- Scenario 2: Ship refined fuel from Ngqura to Durban and then transport via the MPP24 to Gauteng.

3.1.1 SCENARIO 1: MTHOMBO REFINERY WITH NGP

This scenario envisages the building of a new pipeline from Ngqura to link into the current network at either Kroonstad or Jameson Park near Heidelberg, Gauteng. The new pipeline will be commissioned in the same year that the Mthombo refinery comes online.

The assumption in this scenario is that the Mthombo refinery will be constructed and commissioned by 2025. With the implementation of additional refining capacity South Africa will become a net exporter of petrol for approximately 10 years.

This scenario has significant implications for the utilisation and capacity expansion plans of the 24-inch Multi-Product Pipeline (MPP24) during the next 15 to 20 years. The implications for the MPP24 are, due to the under-utilisation of existing capacity for a period of time, that the pipeline tariffs will increase and the current capacity expansion plans require adjustment accordingly.

The building of the Ngqura pipeline does not impact on all of the future MPP24 investments. The investment in TM2 at Jameson Park will still be required to accommodate the increased demand. Consequently, only the investments in the additional MPP24 pump stations and TM1 (Island View) will be postponed. The footprint of TM2 needs to be reviewed to accommodate the full supply from both pipelines.

The timing of the investment decision and subsequent implementation of the new refinery will impact the investment plan of the MPP24.

3.1.2 SCENARIO 2: MTHOMBO REFINERY WITH COASTAL SHIPPING TO DURBAN

Scenario 2 does not include the proposed Ngqura to Gauteng pipeline (NGP). This scenario rather assumes that coastal shipping will be used to transport the refined fuel from the port of Ngqura to the port of Durban from where it will be transported in the MPP24 to Gauteng. This will require additional berth capacity at both Ngqura and Durban.

The demand growth assumptions remain for scenario 1.

This scenario assumes the original design expansion plan for the MPP24 subject to demand growth fluctuations.
3.1.3 MTHOMBO IMPACT REFINED FUELS IMPORTS

Total liquid fuel volumes moved in and through South Africa are expected to grow from the current 30 billion litres to more than 85 billion litres by 2044. The graph below illustrates the supply and demand balance. The various demand curves are offset by local production and imports. With a delay in the implementation of Mthombo, the period of over-supply would move out in time and oversupply will be reduced, as the market will be able to absorb more local production.

![Figure 13: Total Liquid Fuels Supply and Demand Forecast](image)

3.2 24 INCH MULTI-PRODUCT PIPELINE (MPP24)

The South African economy depends on the secure supply of fuel, notably into the inland region, where the demand for fuel based on the long-term forecast is growing from an expected 19.2 billion litres per annum in 2015 to approximately 55.9 billion litres per annum in 2044.

The pipeline also needs to have sufficient spare capacity to service a major supply disruption from the Coal to Liquids (CTL) plants at Secunda. The MPP24 is replacing the 12-inch DJP and has a capacity of 8.7 billion litres per annum and at full capacity will be able to deliver 26.3 billion litres per annum.

The MPP24 is aligned with the Energy Security Master Plan of the Department of Energy. The pipeline is 555km and the system consists of a trunk line and two accumulator terminals, one on either side of the pipeline, i.e. TM1 in Durban and TM2 at Jameson Park in Gauteng.

The coastal terminal (TM1) will receive product from various suppliers in Durban from where it will be injected into the trunk line. The scheduling of the trunk line will be driven by the demand in the off-take areas, the maximisation of batch sizes and the minimisation of the interfaces between products.

The product is received in the inland accumulator terminal (TM2) at Jameson Park from where it is transported into various pipelines to final destination at oil industry storage depots. The inland terminal can also receive product from Natref (Sasolburg) and Sasol 2 and 3 (Secunda). In exceptional cases, products can bypass the inland terminal for direct delivery to industry storage facilities.
For the first phase of the implementation, the MPP24 will have five pump stations – one at TM1, three along the route and one at TM2. Adding additional pump stations to the system can increase capacity.

The interface or intermix will be stored at Jameson Park accumulator terminal (TM2) until a batch can be scheduled to be transported by pipeline for processing at the refractionator at the Tarlton Depot.

The MPP24 was constructed in accordance with best practice in the field of pipeline construction, reflecting the significant advances that have been made over the years in pipeline and construction technology.

The following table show the MPP24 capacity expansion options for the two scenarios:

<table>
<thead>
<tr>
<th>MPP24 expansion year</th>
<th>MPP24 design capacity (billion litres)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scenario 1: Ngqura - Gauteng pipeline</td>
</tr>
<tr>
<td>2015</td>
<td>9,0</td>
</tr>
<tr>
<td>2018</td>
<td>14,3</td>
</tr>
<tr>
<td>2026</td>
<td>14,3</td>
</tr>
<tr>
<td>2030</td>
<td>14,3</td>
</tr>
<tr>
<td>2035</td>
<td>17,8</td>
</tr>
<tr>
<td>2037</td>
<td>24,0</td>
</tr>
<tr>
<td>2044</td>
<td>24,0</td>
</tr>
</tbody>
</table>

Table 10: Timing of MPP24 Pipeline Capacity Expansion for the Two Scenarios

The key issues that will impact the timing of the expansions are:

- The inland market demand growth;
- The ability of the inland refineries to supply a minimum base load of fuel;
- The building of a new pipeline from the proposed Mthombo refinery which could delay part of the phase 3 expansion to the 2030 to 2035 period; and
- Security of supply considerations.

It should be noted that due to the delay in the Mthombo refinery decision, the full phase 2 expansion investments will be incurred. (TM2 tanks will have to be built as well as the Kroonstad to Sasolburg pipeline leg). Based on the timing of the Mthombo refinery decision, the phase 3 expansions may be required in either 2026 (no NGP) or 2035 (with NGP). It is thus critical that the investment decisions be coordinated at a national level between the Government entities involved.

The following graph shows the utilisation of the MPP24 and NGP (scenario 1) and the impact on the timing of the planned MPP24 expansion phases.
The figure above shows the delayed expansion of the MPP24 as product is transported inland in the new NGP from the Mthombo refinery.

The following table shows the volumes transported in each of the pipelines for the 30-year planning period.

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</tr>
</thead>
<tbody>
<tr>
<td>DJP</td>
<td>2.5</td>
<td>1.4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Petrol</td>
<td>2.5</td>
<td>1.4</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Diesel</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Jet</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>MPP24</td>
<td>4.3</td>
<td>5.5</td>
<td>7.6</td>
<td>9.1</td>
<td>9.6</td>
<td>10.0</td>
<td>11.3</td>
<td>13.2</td>
<td>11.8</td>
<td>25.3</td>
</tr>
<tr>
<td>Petrol</td>
<td>0.0</td>
<td>1.1</td>
<td>2.7</td>
<td>3.0</td>
<td>3.2</td>
<td>3.3</td>
<td>3.5</td>
<td>3.8</td>
<td>1.9</td>
<td>3.6</td>
</tr>
<tr>
<td>Diesel</td>
<td>4.3</td>
<td>4.4</td>
<td>4.9</td>
<td>5.3</td>
<td>5.7</td>
<td>5.9</td>
<td>6.9</td>
<td>8.5</td>
<td>8.8</td>
<td>19.9</td>
</tr>
<tr>
<td>Jet</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.7</td>
<td>0.8</td>
<td>0.8</td>
<td>0.9</td>
<td>1.0</td>
<td>1.1</td>
<td>1.8</td>
</tr>
<tr>
<td>NGP</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>9.9</td>
<td>9.7</td>
</tr>
<tr>
<td>Petrol</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2.9</td>
<td>2.8</td>
</tr>
<tr>
<td>Diesel</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>6.7</td>
<td>6.6</td>
</tr>
<tr>
<td>Jet</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6.8</td>
<td>7.0</td>
<td>7.6</td>
<td>9.1</td>
<td>9.6</td>
<td>10.0</td>
<td>11.3</td>
<td>13.2</td>
<td>21.7</td>
<td>34.9</td>
</tr>
</tbody>
</table>

*Billion litres per annum*

*Table 11: Liquid Fuel Pipeline Utilisation DJP, MPP24 and NGP (Scenario 1)*
The figure below shows the phased expansion of the MPP24 through time as product demand increases and supply is imported through Durban either from Mthombo or other sources (scenario 2).

It is evident from the figure that the MPP24 phase 2 expansion will be required before the refinery is built.

This will put additional pressure on a no pipeline scenario for Mthombo as the MPP24 phase 2 will increase capacity to 14.3 billion litres per annum and as indicated in the figure above will be underutilised for at least five years until demand growth has caught up with installed capacity.

Figure 15: MPP24 Pipeline Capacity Utilisation for Scenario 2
3.3 Refined Fuel Pipeline Network

3.3.1 Network Diagram

The supply and demand patterns must be regularly assessed and the flow patterns in the pipeline network will need to respond to such changes.

The following two diagrams indicate the schematic layout of the pipeline system for 2015 and 2020. The key difference is the decommissioning of the DJP.

![Pipeline Network Diagram for 2015 and 2020 (Scenario 2)](image)

Figure 16: Pipeline Network Diagram for 2015 and 2020 (Scenario 2)

3.3.2 Network Utilisation

The following diagrams indicate the pipeline utilisation for the various liquid fuels pipelines in the network for 2015, 2034 and 2044 based on average monthly pipeline demand.

![Network Utilisation for 2015 Based on Average Monthly Pipeline Demand (Scenario 2)](image)

Figure 17: Network Utilisation for 2015 Based on Average Monthly Pipeline Demand (Scenario 2)
Note that in the 2044 diagram the Jameson Park – Kendal, Kendal – Waltloo, Jameson Park – Alrode (Diesel) and Tarlton – Rustenburg line sections and the MPP24 exceed the installed capacity.

The following diagrams indicate the pipeline utilisation through time (2015 to 2044) and show when the regional sections of the pipeline network become constrained. The average and peak seasonal demand is shown for the MPP24 (trunk line) and the utilisation for average demand in the eastern, western and northern sections of the pipeline system. Each pipeline section is shown separately for the various network regions.
3.3.3 MULTI-PRODUCT PIPELINE (MPP24)

Regular pipeline expansions (additional pump stations and tanks) are scheduled for the MPP24 to alleviate any constraints that might occur. The pipeline becomes constrained for scenario 2 in 2038. An alternative corridor to the inland area will be required when the MPP24 becomes constraint.

3.3.4 EASTERN NETWORK

The eastern network comprises pipelines running from Secunda to Jameson Park, to Kendal node and on to Waltloo and Witbank. The eastern network has sufficient capacity until 2040, where after the Jameson Park - Kendal, Kendal Waltloo and Kendal - Witbank line sections require additional capacity.
3.3.5 WESTERN NETWORK

The western network comprises pipelines running from Natref in Sasolburg to Jameson Park, south to Kroonstad and west to Klerksdorp. It also includes the dedicated Avtur pipeline.

This is a high level pipeline capacity diagram and does not consider operational capacity planning considerations

Figure 23: Western Network – Refined Products (Average Demand)

3.3.6 NORTHERN NETWORK

The northern network comprises the pipeline running from Jameson Park though the Alrode node to Rustenburg and O.R. Tambo International Airport (ORTIA).

The northern network has sufficient capacity until 2040, where after the Tarlton – Rustenburg and Jameson Park – Alrode Diesel line sections require additional capacity.

3.3.7 JET FUEL PIPELINE

The following diagrams indicate the schematic layout and capacity of the jet fuel pipelines in the inland for 2015 and 2020. Note the addition of the dedicated jet fuel pipeline from Jameson Park to ORTIA to supplement jet fuel supply by pipeline from the coast. The following diagram indicates the jet fuel pipeline utilisation for 2015, 2024, 2034 and 2044:

Figure 25: Jet Fuel Pipeline Schematic Layout for 2014 and 2020
A key issue for the transport of jet fuel in the MPP24 is the compliance to the Clean Fuels 2 product specifications. Jet fuel has high sulphur contents, hence a technical solution needs to be found to transport jet fuel and very low sulphur (10ppm) refined products in the MPP24 and manage the resulting intermixtures. The figure below depicts the options to manage the impact of jet fuel supply to ORTIA.
With the introduction of biofuels in 2015 and the associated compatibility issues with jet fuel (cross contamination with fatty acid methyl ester (FAME) no biofuels will be transported in the Transnet pipeline network.
3.4 CRUDE OIL PIPELINE

The capacity utilisation map below indicates that sufficient capacity exists in the system for the 30-year planning period.

![Crude Oil Pipeline Schematic and Pipeline Information](image)

<table>
<thead>
<tr>
<th>Origin</th>
<th>Destination</th>
<th>Diameter (inches)</th>
<th>Maximum flow rate (m³/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fynnlands</td>
<td>Newcastle</td>
<td>16&quot;</td>
<td>840</td>
</tr>
<tr>
<td>Newcastle</td>
<td>Vrede</td>
<td>16&quot;</td>
<td>840</td>
</tr>
<tr>
<td>Vrede</td>
<td>Coalbrook</td>
<td>18&quot;</td>
<td>840</td>
</tr>
<tr>
<td>Vrede</td>
<td>Secunda</td>
<td>20&quot;</td>
<td>840</td>
</tr>
</tbody>
</table>

Figure 29: Crude Oil Pipeline Schematic and Pipeline Information

The diagram below indicates the crude oil pipeline system. Although the section from Vrede to Secunda was part of the original system to Ogies (near Kendal) it is currently not in service. The various line sections, diameters and flow rates are shown in the table adjacent.

![Crude Oil Pipeline Capacity Utilisation Map](image)

Figure 30: Crude Oil Pipeline Capacity Utilisation Map

Transnet SOC Ltd © LTPF 2016
3.5 GAS PIPELINE

3.5.1 ROMPCO PIPELINE

Sasol’s natural gas is supplied via the 865km ROMPCO natural gas transmission pipeline from the Pande and Temane Gas Field in Mozambique, to Sasol’s plants in Secunda and Sasolburg. The pipeline is 50% owned by Sasol, 25% by the South African Government (CEF) and the other 25% by the Mozambique Government. The existing pipeline is being expanded with the introduction of loop lines to ramp up to 147 million GJ.

3.5.2 TRANSNET’S GAS PIPELINE

The following schematic indicates the Lilly pipeline sections and utilisation through time.

![Pipeline utilisation map 2015](image)

![Pipeline utilisation map 2024](image)

![Pipeline utilisation map 2034](image)

![Pipeline utilisation map 2044](image)

Figure 31: Lilly Pipeline Utilisation for Period 2015 to 2044

3.5.3 MULTI-PRODUCT PIPELINE (MPP24)

From the forecast it is evident that the section between Secunda and Newcastle will become constrained towards 2024. The current operator of the pipeline doesn’t require higher capacity, therefore the capacity is planned to be maintained at the current capacity.

![Figure 32: Lilly Pipeline Capacity Utilisation 2015 to 2044 (Average Demand)](image)
3.6 POTENTIAL NEW PIPELINES

All new pipeline routes will be selected such that the routing avoids vulnerable areas in order to ensure environmental sustainability. Areas of dense population concentration will be avoided as far as possible to minimise adverse social impacts.

The building of the Ngqura pipeline would postpone the expansion plans for the MPP24 line and reduce the need to invest in additional berth capacity for liquid fuels at Ngqura and Durban.

The figure below illustrates the utilisation for both the MPP24 and NGP pipelines, for scenario 1.

<table>
<thead>
<tr>
<th>Origin</th>
<th>Destination</th>
<th>Diameter (inches)</th>
<th>Maximum flow rate (m³/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port Elizabeth</td>
<td>Bloemfontein</td>
<td>ø 18”</td>
<td>1 500*</td>
</tr>
<tr>
<td>Bloemfontein</td>
<td>Kroonstad</td>
<td>ø 18”</td>
<td>1 500*</td>
</tr>
<tr>
<td>Kroonstad</td>
<td>Jameson Park</td>
<td>ø 18”</td>
<td>1 500*</td>
</tr>
</tbody>
</table>

* Considering 90% utilisation

Figure 33: Schematic Layout of NGP
3.6.1 NGQURA TO GAUTENG PIPELINE (SCENARIO 1)

The Ngqura to Gauteng pipeline assumes that a 300 000bpd Mthombo refinery will be built in the Coega IDZ in 2025. The 18-inch pipeline will transport product from the Mthombo refinery, inland.

The pipeline will deliver product to Bloemfontein and Kroonstad along the way. The pipeline will connect to the Jameson Park terminal from where product will be distributed to other depots in the inland network.

The schematic illustration shows the impact that utilisation of the 300 000bpd Mthombo refinery and the Ngqura pipeline will have on current infrastructure by 2034.

**Average Demand**

|------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|      |
| MPP24            |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Coega Pipeline   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |

**Figure 34: Pipeline Utilisation Map of NGP (2034) (Peak Demand)**

**Figure 35: Pipeline Capacity Utilisation for MPP24 and NGP (Average Demand)**
3.6.2 MAPUTO TO GAUTENG PIPELINE

NERSA awarded a licence on 29 March 2007 to Petroline to construct a 12-inch liquid fuels pipeline from Mozambique to Kendal via Nelspruit and to build a petroleum storage facility at Nelspruit.

The proposed pipeline is approximately 400km long with 80km being in Mozambique. The section from the border to Nelspruit is approximately 110km. The pipeline will originate from Matola bulk terminal in the Port of Maputo. The design capacity of the pipeline is 3.5 billion litres per annum.

The pipeline licence has been extended to 25 years. The project was delayed due to the extraordinary time to acquire environmental approvals. The construction of the pipeline has not started and given the introduction of the MPP24, it is not foreseen that it will be built in the near future.

![Figure 36: Proposed Maputo to Gauteng Pipeline](image)

The petroleum storage facility at Nelspruit will have a capacity of 30 000m³: 10 000m³ for petrol and 20 000m³ for diesel. Despatch from the facility will be by road and rail. The despatch gantries will be capable of handling 1.5 billion litres of product per annum.

On 30 January 2008, the regulator approved an increase in the pipeline diameter to 16-inches, as well as the construction of storage, intermix and accumulator tanks at Kendal. This was approved on the basis that the capacity be maintained at 3.5 billion litres per annum.
3.6.3 REFINED FUEL PIPELINE TO BOTSWANA

The Botswana liquid fuel demand is in excess of 1 billion litres per annum and a pipeline option for the supply to Gaborone should be investigated.

Two options are considered for this new pipeline:

- A new line from Tarlton to Tshele Hills;
- Upgrading the existing pipeline from Tarlton to Rustenburg and construct a new pipeline between Rustenburg and Tshele Hills.

Different routing options are shown in the figure below.

Figure 37: Proposed Gaborone Refined Product Pipeline
3.6.4 JET FUEL PIPELINE FOR CAPE TOWN INTERNATIONAL AIRPORT (CTIA)

Currently, jet fuel is trucked directly from Chevron Refinery to Cape Town International Airport (CTIA). With increasing demand and supply in the long-term, a pipeline may be economically viable. A new pipeline from Chevron Refinery to the Cape Town International Airport is proposed.

Figure 38: Proposed Chevron to CTIA Jet Fuel Pipeline
PIPEDLINE DEVELOPMENT PLAN

3.6.5 JET FUEL PIPELINE FOR KING SHAKA INTERNATIONAL AIRPORT (KSIA)

The building of a jet fuel pipeline to supply the King Shaka International Airport (KSIA) at La Mercy in Durban should be investigated in future when demand increases to warrant the capital investment. Current demand at the airport is low and jet fuel is supplied by road tankers.

3.6.6 NEW GAS PIPELINES

Gas is becoming an important energy commodity within SA, especially with the plans for increased electricity generation from gas. Gas infrastructure is required to grow a gas economy in the country.

South Africa is reviewing opportunities to import new resources of natural gas. Possible sources of gas include the Mozambique gas developments in Palma, the development of the offshore Ibhubesi and Ikhwesi fields, Kudu gas field in Namibia and the on-shore potential Karoo shale gas and coal bed methane deposits in Waterberg and Botswana Morupule region. The pipeline networks associated with the possible gas facilities are discussed in more detail in the Gas chapter.

3.7 PIPELINE PROPERTY PLANNING

Transnet’s Pipeline network comprises approximately 3 800km of pipeline routes on an area of 2 280 hectares of land. Most pipelines in South Africa are laid underground as pipelines laid above ground are vulnerable to potential damage and deterioration. Pipelines are often laid in servitudes of 6m width, though this might not be the case throughout the route due to constraints in urban areas by existing development. Encroachment into pipeline servitudes seems to be an increasing problem in South Africa. This is considered when installing a new pipeline.

The table provides a summary of the existing Transnet Pipeline properties:

<table>
<thead>
<tr>
<th>Pipeline</th>
<th>Estimated Area (Hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refined products</td>
<td>495,0</td>
</tr>
<tr>
<td>Crude oil</td>
<td>348,0</td>
</tr>
<tr>
<td>Gas</td>
<td>360,0</td>
</tr>
<tr>
<td>Avtur</td>
<td>56,4</td>
</tr>
<tr>
<td>MPP24</td>
<td>422,4</td>
</tr>
</tbody>
</table>

Note: Figures are only estimates and are not inclusive of the Depo’s and servitutes

Table 12: Existing Transnet Pipeline Properties
4. ACCUMULATOR AND STORAGE FACILITIES

4.1 MPP24 ACCUMULATOR TERMINALS

The function of the accumulator terminals is to decouple the MPP24 from the upstream supply and downstream demand variations and thus enable Transnet Pipelines to optimise the batching of product and minimise inter mixture generation.

The Island View Terminal (TM1) in the Port of Durban functions as an accumulator of supplies from various sources, such as refineries and import facilities located in Durban. The Jameson Park Terminal (TM2) in Gauteng accumulates product from the MPP24 and inland suppliers (e.g. Secunda and Natref) and facilitates the supply of product into the inland network linked to the oil industry depots. This requires complex integrated system planning and scheduling capability to enable the system to perform optimally for a given capacity investment.

The accumulator terminals are currently being constructed and it is envisaged that the system will run in a ‘tightline’ configuration at TM1 until the TM1 terminal is commissioned.

4.1.1 TERMINAL 1: ISLAND VIEW IN THE PORT OF DURBAN

The initial configuration of the terminal (TM1) at Island View in the Port of Durban will consist of 10 product tanks for petrol, diesel and jet fuel as indicated in the table below. It is important to note that the capacity of the individual tanks will differ from that at Jameson Park. The total installed capacity will be 196 000m³.

![Figure 39: Construction of TM1 at Island View in Durban and Tank Configuration](image)

<table>
<thead>
<tr>
<th>Tank Capacity m³</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULSD</td>
<td>18 000</td>
</tr>
<tr>
<td>LSD</td>
<td>22 000</td>
</tr>
<tr>
<td>ULP 95</td>
<td>26 000</td>
</tr>
<tr>
<td>ULP 93</td>
<td>32 667</td>
</tr>
<tr>
<td>Jet</td>
<td>46 000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Number of Tanks</th>
<th>2</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Volume</td>
<td>196 000 m³</td>
<td></td>
</tr>
</tbody>
</table>

The planned capacity of the terminal by 2044 is 354 450m³ excluding any capacity to provide for product import capability in Durban.

The table below indicates the current expansion plans of TM1 through to 2030. For the period up to 2030, sufficient installed capacity is available to meet the peak demand requirements.

<table>
<thead>
<tr>
<th>Tank capacity (m³)</th>
<th>2012 - 2015</th>
<th>2015 - 2020</th>
<th>2020 - 2025</th>
<th>2025 - 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total tanks</td>
<td>20 000</td>
<td>22 000</td>
<td>20 000</td>
<td>23 000</td>
</tr>
<tr>
<td>Total capacity per tank size</td>
<td>140 000</td>
<td>160 000</td>
<td>140 000</td>
<td>160 000</td>
</tr>
<tr>
<td>Total capacity</td>
<td>206 000</td>
<td>264 000</td>
<td>304 000</td>
<td>358 000</td>
</tr>
</tbody>
</table>

Table 13: Island View Accumulator Terminal TM1 – Tank Capacity
4.1.2 TERMINAL 2: JAMESON PARK IN GAUTENG

The initial configuration of the terminal TM2 at Jameson Park will consist of 10 product tanks for petrol, diesel and jet fuel. The total installed capacity will be 180 000m³. The design made provision for two grades of petrol and two grades of diesel. With the implementation of the Clean Fuels 2 programme only one grade of diesel (10ppm sulphur) will be required.

Figure 41: Construction of TM2 at Jameson Park and Tank Configuration

The site has been designed to expand to 400 000m³ by 2044. The table below indicates the number of tanks and volumes in TM2 required over time to meet the average monthly forecasted demand and additional capacity required to meet the peak demand requirements for the period.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank capacity (m³)</td>
<td>10 000</td>
<td>20 000</td>
<td>10 000</td>
<td>20 000</td>
</tr>
<tr>
<td>Total tanks</td>
<td>2</td>
<td>8</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Total capacity per tank size</td>
<td>20 000</td>
<td>160 000</td>
<td>20 000</td>
<td>160 000</td>
</tr>
<tr>
<td>Total capacity</td>
<td>180 000</td>
<td>180 000</td>
<td>240 000</td>
<td>280 000</td>
</tr>
</tbody>
</table>

Table 14: Jameson Park Accumulator Terminal TM2 – Tank Capacity

The above planning numbers assume jet fuel will be transported via the MPP24.

The market penetration of fuel grades continuously change through time. Changes in terminal tank configuration will be required to accommodate fuel grade changes. The market requires monitoring to determine the needs through time.
4.2 DURBAN FUEL IMPORT TERMINAL (DFIT)

As South Africa is short of refined product, it is forecasted that large volumes of product need to be imported, specifically through the port of Durban, in order to meet the demand of the Durban Gauteng corridor.

The timing and size of a new refinery will determine if the country will revert to being a net exporter of fuels. The delay in the expansion of local manufacturing capacity will result in a steady increase in imports.

The oil infrastructure within South Africa has always been geared towards crude imports and the export or coastal shipping of liquid fuel products. This has now changed and the oil infrastructure in the ports needs to be geared for imports, specifically those ports servicing the Gauteng hinterland and to a lesser extent Cape Town. The timing of the new crude oil refinery decision has major implications for the development of liquid fuel infrastructure in ports and the diversification of liquid fuels infrastructure to other corridors, which is currently skewed towards Durban.

From a policy perspective, the Department of Energy (DOE) needs to decide if SA should continue to develop a liquid fuels manufacturing industry or import all liquid fuels final products. This has implications for the development of liquid fuels infrastructure as long periods of high imports will necessitate infrastructure, which will to a large extent be made redundant, if imports are switched to crude oil (new refinery built). The solution is an integrated one, comprising an integrated decision approach from DOE, Transnet and the oil industry.

Figure 42: Durban – Gauteng MPP24 Pipeline Coastal Supply and Inland Terminal Network
4.3 PRIVATELY OWNED TERMINALS

The large commercial liquid fuels terminal storage facilities in South Africa are mainly owned and operated by oil majors including Sasol. These facilities are linked to refineries, pipelines and ports. Independent terminal operators have entered the liquid fuels market to provide storage and handling facilities to the market.

Tanks are essential for refineries to enable them to move product or components across the berth either as an import for blending, final distribution or export of final products or components. The storage facilities act as a buffer in the distribution system and also provide adequate cover for disruptions in the supply chain during normal business operations.

The logical flow diagram below depicts the berths in the Port of Durban, the oil refineries, transmission and feeder pipelines, major tank farms and storage depots. VOPAK and IVS are privately owned (independent third parties), while the TM1 terminal (Durban), the TM2 terminal (Gauteng) and the Tarlton depot (northern network) are owned by Transnet. The Airports Company of South Africa (ACSA) owns the jet fuel facilities at O.R. Tambo International Airport.

Figure 43: Island View Back of Port Oil Storage Infrastructure
Lack of sufficient storage capacity and ability to evacuate product from these facilities situated at the end of the pipeline network, i.e. at delivery locations, can severely impact pipeline capacity. The storage depots form an integral part of the pipeline system.

The need to develop an independent import and storage facility in Durban that is linked to the pipeline system, is important for the effective and efficient operation of the liquid fuels market in South Africa. Such an import terminal would always be needed as the country would always need to import fuels, specifically during planned shutdowns and refinery turnarounds.

Independent terminal operators and logistics companies are entering the liquid fuels terminal market in South Africa. NERSA has awarded a construction licence to independent terminal operators for terminals close to the current MPP24 inland accumulator terminal at Jameson Park and in the ports of Cape Town, Ngqura and Richards Bay. Independent terminal operators have also been awarded licences to expand their facilities in Island View to service the oil industry.

4.3.1 STRATEGIC RESERVES

The Department of Energy (DOE) indicated in a draft regulation, dated March 2013, that the South African Government needs to hold strategic stocks equivalent to 60 days of net imports. The 60 days of strategic stocks is split between crude oil and finished product, with 42 days as crude oil and 18 days as finished product.

Sufficient crude oil storage capacity exists, but there are no strategic storage facilities for finished product in South Africa. According to draft legislation, South Africa should have 1,3 billion litres (2015 volumes) of finished product as strategic stock. Considering an average tank size of 20 000m³, this equates to 65 tanks.
PI PELINE DEVELOPMENT PLAN

It is recommended that strategic storage facilities should be close to the market and integrated with the existing transport infrastructure, specifically pipelines. This implies that strategic storage facilities for finished product should be established in the major supply centres or points that normally serve the supply to the demand enclaves and where the associated logistics already exists. Possible sites for strategic storage facilities include Jameson Park, Alrode, Langlaagte, Tarlton, Rustenburg, Watloo, Witbank, Sasolburg and Secunda.

This provides an opportunity for the development of mega-terminals to achieve economies of scale and open the market for independent terminal operators.

4.3.2 PORT OF CAPE TOWN

In 2013 Burgan Cape Terminals was awarded a 20-year contract by the Transnet National Ports Authority to develop a fuel storage and distribution facility at the Eastern Mole of the Port of Cape Town. The development is intended to improve security of fuel supply and associated flexibility, both of which are key economic imperatives and policy goals for South Africa. It will be a multi-purpose facility used for the storage and distribution of both locally produced and imported fuels.

4.3.3 JAMESON PARK

VOPAK has entered the market to provide storage and handling facilities to existing and new customers in the oil industry. VOPAK is investigating the feasibility of strategic reserve facilities at their proposed Jameson Park facility.

4.3.4 PORT OF NGQURA

OTGC has been awarded the bid by TNPA to develop oil storage facilities in the port Ngqura to replace the oil industry facilities currently operating from PE. OTGC anticipates to include strategic reserves in the facility in the Port of Ngqura.

4.4 LIQUID FUELS TERMINAL OPPORTUNITIES IN SOUTH AFRICA

The following opportunities exist and should be investigated in more detail (investments for certain opportunities are included in the investment overview):

- Development of a fuel import terminal in Durban;
- Development of strategic stock storage facilities in conjunction with private sector entities; and
- Development of new storage facilities linked to the pipeline system.

**Durban Fuel Import Terminal**

Transnet recently completed a planning study for the development of a fuel import terminal and concluded Durban to be the viable location. South Africa is currently a net importer of refined fuels and assuming no significant increase in local refining capacity, importing is forecast to grow to 59 billion litres over the next 30 years. The Liquid Fuels Charter requires new entrants into the liquid fuels market and the concept of a common user import fuel facility would allow 3rd party access to the liquid fuel supply chain, facilitating transformation of the fuel supply sector and further ensuring security of fuel supply in South Africa.

The fuel import terminal would also facilitate SADC’s initiatives towards better regional integration, especially for landlocked countries that border South Africa, by facilitating a more independent logistics channel through South Africa, thereby better ensuring their own security of supply. The planning study confirmed a common user import terminal would allow new players to import liquid fuel products, mainly by way of consolidating smaller, individual orders, to achieve economies of scale in chartering liquid bulk vessels.
5. NEW EMERGING TECHNOLOGIES

The introduction of new technologies will ensure that Transnet operates and maintain their pipelines in a sustainable manner.

5.1 EMERGING TECHNOLOGIES IN PIPELINES

5.1.1 COST REDUCTION TECHNOLOGIES

Developments in energy, slurry and capsule pipeline technology are focusing on reducing the cost of transporting pipeline materials, as well as increasing the durability and reducing the corrosion potential. This is done by the introduction of new internal and external lining materials (e.g. fibre). Polyethylene materials also enhance seismic strength of pipelines and perform better with underground deformation stresses.

Improved construction techniques are resulting in reduced implementation risks and construction costs. Trenchless pipelines are significantly cheaper to install and maintain, and allows easy accessibility for emergency repairs.

A reduction in pumping costs is also being pursued by using drag and turbulence-reducing additive materials such as polyox and guar gum. The preference is for water soluble materials that can be safely used in pipelines. Thermoplastics, such as polyox water-soluble resins, are readily calendared, extruded, injection moulded, or cast. Sheets and films of these materials are heat-sealable and can be oriented to develop high strength. Films are inherently flexible, tough and resistant to most oils and greases. These resins are compatible with many natural and synthetic polymers. These new films can be cured in pipelines in-situ.

5.1.2 MONITORING AND LEAK DETECTION TECHNOLOGY

New leak detection technologies, that rely on acoustic tests, infrared and radar equipment, can detect and map leaks underground. GIS provides satellite mapping of stress and strain on existing structures to give early warning of catastrophic failure. These technologies will also reduce costs to rehabilitate underground pipelines.

The introduction of Unmanned Aerial Vehicles (UAVs) or drones for the monitoring of pipelines is an exciting new technology that can assist in the early detection of leaks and other operational problems. This can also assist in predictive maintenance with pipelines in areas that are not easily accessible.

5.1.3 ENERGY EFFICIENCY

Compressor and pump efficiency can be improved through various new initiatives. Turbochargers, waste heat recovery and high-pressure fuel injection for engines which drive pumping systems are expected to dominate new designs in future. This continually reduces the energy requirements.

The introduction of pump-out slots on impeller wear rings and rotating throat sleeves can prevent solids, contained in liquids, to accumulate at wear rings and in stuffing boxes. On the downside pump-out slots causes more internal recirculation, reducing initial efficiency by up to 4%. However, it has been shown that after a few years the efficiency reduction is only 0.5%.

The use of multi-fuel pumping systems and compressors that can run on both liquid fuels and natural gas, as well as on mixtures of liquid fuel and gas, may generate reliable power from ‘fuel off the well’. Engines for pumping systems and compressors that can burn either crude oil or associated gas or combinations thereof are also becoming available. This enhances the capability to run such systems under remote control with a continuous fuel supply from the product that is being transported.

5.1.4 METERING

In recent years, ultrasonic metering systems are gaining acceptance in the petroleum industry. The key features driving this technology are high accuracy and low maintenance. Ultrasonic metering can operate in a wide range of viscosities and has self-diagnostic functionality. When compared with traditional measuring techniques such as the Coriolis device, turbine meter and Positive Displacement Meter (PDM), the ultrasonic meter offers much more benefit.
5.2 ENGINE EFFICIENCY

5.2.1 ENGINE TECHNOLOGY

Fuel demand will continue to be impacted by improvements in engine technology with diesel being recognised to be significantly (>50%) more energy efficient than petrol engines. Sales of diesel passenger vehicles still battle with perceptual issues concerning noise and pollution and with the increases in price of diesel relative to petrol the current cost of ownership is equitable.

Petrol engine developers employ as many of the diesel technologies as possible, e.g. direct injection, increased combustion pressures. Turbo technology and energy recovery systems (ERS) boost petrol engine performance, leading to reduced fuel consumption.

The introduction of the Government’s Clean Fuels 2 Programme will also open the market for more fuel-efficient vehicles in South Africa.

5.2.2 HYBRID TECHNOLOGY

Hybrid electric vehicles (HEV) are becoming prevalent in North America and Europe and are twice as efficient as normal piston/cylinder vehicles.

Plug-in hybrid electric vehicles (PHEV) have become commercially attractive. PHEVs can generate more electricity than it consumes and can feed excess energy back into the grid. PHEVs require overnight charging but charge cycles are getting shorter and batteries better. The aim in the United States is to have fuel capacity for passenger vehicles of about 480km per day; Tesla (high-performance hybrid vehicle) can drive 350km per day between charges. A variety of scenarios of low carbon electricity generation coupled with PHEVs are being configured for the United States.

Fuel cells are not yet viable for commercial use in transportation vehicles. Fuel cells running on hydrogen, methanol and microbial organics are being considered. The storage of hydrogen (energy medium) is currently challenging, but a variety of technologies are being investigated. Service stations with hydrogen supply are still a rare sight.

Fuel flex cars are becoming popular in the United States (±7 million currently), since these engines can accommodate not only petrol, but also 85% ethanol blends.

All the above new technologies will reduce the consumption of liquid fuels per unit distance travelled in future. Petrol engine efficiency combined with energy recovery systems would appear to be improving at a faster rate than developments in diesel technology.

5.2.3 DEVELOPMENTS IN AVIATION

The improvement in aircraft design and engine technology, turbine and reciprocating, will impact demand for jet fuel and Avgas. Light aircraft engine manufacturers are introducing diesel options using jet fuel (kerosene) to replace high octane gasoline engines.

The replacement of old aircraft with new fuel efficient models will reduce fuel consumption over the next decade. Greater reductions in fuel consumption will be achieved through radical new designs i.e. incorporating blended wing concepts, estimated to reduce fuel consumption per seat by up to 38%.

5.3 BIOFUELS

A draft position paper on the South African biofuels regulatory framework was published in January 2014. The reference feedstock will be grain sorghum for bioethanol and soya beans for biodiesel production. Maize will be excluded as feedstock.

Mandatory blending of bioethanol into petrol and biodiesel into diesel was set for 1 October 2015. Allowable ethanol blends of 2% to 10% (volumetric) will depend on the oxygenate volatility specifications of the blended petrol. Diesel blends of 5% to 100%
biodiesel will be allowed.

No settlement has been reached on the pricing framework. However, incentives such as a 50% rebate on the general fuel levy for biodiesel, manufacturers and a fuel tax exemption for bioethanol producers has been insufficient to lure investments in the biofuels sector.

Licences have been issued to four producers with total indicated capacity of 208 million litres of bioethanol (from sorghum and sugarcane) and 458 million litres of biodiesel (from soya beans). From the licences approved by NERSA there are two main areas for biofuel manufacturing, the Eastern Cape (within the Port Elizabeth, Cradock and East London triangle) and the north-western Free State (Bothaville). The depots in the Port Elizabeth, Kroonstad and Klerksdorp regions will therefore probably be the sites where most of the blending will take place. Apart from a few small biodiesel producers, no large scale biofuels producer has emerged as yet. In order to force the implementation of the Biofuels Industrial Strategy a number of mandatory regulations have been imposed.

Estimates of 25 000 new, direct and indirect employment opportunities that will be created are quoted in public. It is widely accepted that the biofuels drive in South Africa is not to support the green initiatives or to supplement fossil fuel production capacity, but to stimulate the second tier economy, i.e. creation of employment opportunities for the poor.

A key issue for pipelines operators is the possible contamination of jet fuel by fatty acid methyl ester (FAME) in multi-product pipelines which contain biodiesel. Current international jet fuel specifications do not allow any FAME in jet fuel. The industry is investigating the negative impact, if any FAME in jet fuel. The United States of America Military specification allows for maximum of 5ppm of FAME. The pipeline shippers would want to pump at least a B5 grade of biodiesel in the pipeline. The FAME cross-contamination with jet fuel will result in larger volumes of intermix (kerosene and diesel) which will have to be reprocessed into usable fuels as it cannot be blended away due to the high sulphur content.

There will be severe stress on the road transport logistical systems to and from these manufacturing sites if the rail infrastructure and management processes are not timeously upgraded for dealing with the transportation of biofuel products. This will apply not only to the biofuels as such, but also the by-products that the manufacturers will have to dispatch.

### 6. Investment Overview

#### 6.1 Transnet Pipelines 30-Year Investment

**Scenario 1: Mthombo Refinery with Ngqura to Gauteng Pipeline**

The investment summary below indicates the expenditure for the scenario where the Ngqura to Gauteng pipeline is built to serve the proposed Mthombo refinery. The expenditure includes the expansion of the MPP24 up to full capacity by adding various pump stations and auxiliary equipment to the system and additional accumulator tanks at TM1 and TM2, with the implementation of phase’s three to five post 2035.

All costs are high-level un-escalated estimates in millions of Rand.

<table>
<thead>
<tr>
<th>Project</th>
<th>Already spent</th>
<th>Seven-year investment plan</th>
<th>Post 7 years</th>
<th>Total project cost</th>
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<td>Other</td>
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<td>1 214 2 739 3 605 3 066 590</td>
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<td>38 658</td>
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</table>

Table 16: Investment Scenario 1: Mthombo Refinery with NGP
6.2 PIPELINE AND TERMINAL OPPORTUNITIES IN SOUTH AFRICA

The investment summary below indicates the various opportunities within South Africa for additional pipelines and terminal storage facilities. The major areas of impact will be the implementation of the Government’s security of supply strategy, such as the building of the new crude oil refinery in Coega IDZ.

The Ngqura to Gauteng pipeline assumptions include: 1,000 km, 18-inch pipeline at a capacity of 1,500 m³/h. The strategic reserves volume assumptions include: 1.3 billion litres of storage for strategic reserves, split by 0.8 billion litres inland and 0.5 billion litres at the coast, and excludes additional crude oil storage facilities.

There are opportunities for LNG development, such as in the Eastern Cape for power generation and feed to PetroSA facilities in Mossel Bay, as well as for imports into Richards Bay or Saldanha Bay.

All cost figures are high-level estimates in millions of Rand (un-escalated).
Figure 46: Investment Scenario 1: Mthombo Refinery with NGP

Figure 47: Investment Scenario 2: Mthombo Refinery with Coastal Shipping to Durban
## PIPELINE DEVELOPMENT PLAN

### Table 18: Transnet Pipelines Seven-year Investment Plan

<table>
<thead>
<tr>
<th>Project</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
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<td>5 397</td>
<td>5 397</td>
<td>17 064</td>
<td>50 805</td>
</tr>
</tbody>
</table>

*Millions*

**Table 18: Transnet Pipelines Seven-year Investment Plan**

**Figure 48: Pipeline and Terminal Storage Opportunities in South Africa**